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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER				
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ART UNIT		PAPER NUMBER		
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/527,202

Applicant(s)

ITANO ET AL.

ExaminerTABASSOM TADAYYON
ESLAMI**Art Unit**

1792

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on 18 March 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 and 12-118 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 12-118, 21, and 23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 12/12/07.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on March 6, 2008 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Where applicant acts as his or her own lexicographer to specifically define a term of a claim contrary to its ordinary meaning, the written description must clearly redefine the claim term and set forth the uncommon definition so as to put one reasonably skilled in the art on notice that the applicant intended to so redefine that claim term. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350, 1357, 52 USPQ2d 1029, 1033 (Fed. Cir. 1999). The term "contracting" in claim 23 is used by the claim to mean "contacting", while the accepted meaning is "touching." The term is indefinite because the specification does not clearly redefine the term.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-5, 12-13, 15 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan.

Claims 1 and 23 are rejected. Claims 1 and 23 require an etching solution and a method of etching with the etching solution when the etching rate of high k material is 2 Å/min or greater and etch rate ratio of the oxide to the high k material is 50 or less. Jagannathan teaches a etching solution and a method for selective removal of oxides [column 2 line 65- column 3 line11], with a solvent comprising of HF (a fluoride-containing compound and an organic solvent, such as diglyme, for removing the oxides such as those commonly used in interlevel dielectrics [column 4 lines 15-233]. While Jagannathan does not explicitly teaches the etch rate and ratio of etch rate and relative dielectric constant properties, these properties are a result of the composition of the etching solution. It would have been obvious to have chosen 20-25% HF because it is within the range disclosed by Jagannathan, the claimed properties would obviously have been provided by the process disclosed by Jagannathan and to have omitted water because Jagannathan prefers water free solvents. *In re Best*, 195 USPQ 433, footnote 4 (CCPA 1977). Therefore, since Jagannathan teaches using the same

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materials (e.g. HF and diglyme) as applicant teaches in example 3 (table 1) in the etching solution in overlapping proportions (e.g. from 0.5 to 15 mol/liter of HF which would include 20-25% HF by weight) it is reasonable to presume that the etching solution of the said reference would inherently have the claimed properties of claims 1-5. The burden is upon the application to prove otherwise. *In re Fitzgerald*, 205 USPQ 594.

Jagannathan further teaches a removal solvent for dielectric materials comprises 0.5-15 molar of fluoride-containing compound and an organic solvent wherein said organic solvent is selected from the group consisting diglyme (claim1). For the solvent with 5 molar of hydrofluoric acid, with the density of diglyme equal to 0.937 gr/cm^3 , if we consider 1 liter of the solution ($937+100=1037 \text{ gr}$), and we have ($5 \times 20=100 \text{ gr}$ of HF in the solution). Therefore the % HF in the solution is $100/1037=\%10$ which is greater than %3. Also the % diglyme is $937/1037=\%90$, which is between 75-97% also the % water, is %0 which is less than %5.

Jagannathan teaches using diglyme, $\text{CH}_3\text{-O- (CH}_2\text{CH}_2\text{-O)}_z\text{-CH}_3$, as the ether compound, therefore claims 1 and 23 are rejected.

Claim 2 is rejected. Jagannathan teaches an etching solution for selectively etching tantalum nitride (high k material $k \sim 100$) vs silicon dioxide [column 3 lines 2-11].

Claim 3 is rejected. Jagannathan teaches an etching solution for selectively etching hafnium oxide film [HfALO, column 3 lines 2-11]

Claim 4 is rejected. Jagannathan teaches an etching solution for selectively etching aluminum alloy (high k, HfAlO) vs silicon dioxide [column 3 lines 2-11].

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Claim 5 is rejected. Jagannathan teaches an etching solution which the etch rate for high k material is 2 °A/ minutes and the relative etching rate of the silicon dioxide film to the high k to is about 50 or less, therefore it is inherent that the etching rate of the silicon oxide film is 100 °A/ min or less.

Claim 12 is rejected. Jagannathan teaches an etching solution which meets the limitation of claim 11 and the ether compound has a relative dielectric constant of 30 or less [dielectric constant of diglyme is 7].

Claim 13 is rejected since Jagannathan discloses using gamma-butyrolactone as the organic solvent (claim 1).

Claim 15 is rejected since Jagannathan teaches the ether compound selected from the group consisting of diglyme [column 4 line 34].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 16 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan in view of Zuel et. al. (US Patent number: 5120605) here after Zuel.

Claim 16 is rejected because although Jagannathan teaches the etching solvent comprising of hydrofluoric acid and an organic component, diglyme, an ether meets the limitation of claim 1 as discussed above, it does not teach using the specific all claimed ethers. However, Zuel teaches an etching solution for oxide surfaces comprising hydrofluoric acid and an ether, diethylene glycol diethyl ether and diethylene glycol monomethyl ether [column 4, line 39-42]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to use the same solution as Jagannathan teaches (HF with the same ratio between the HF and the ether), and have the diethylene glycol monomethyl ether rather than diglyme as etching solution, because Zuel teaches this composition is suitable for etching oxides.

Claim 14 is rejected for the same reason claim 16 is rejected and because of the Diethylene glycol monomethyl ether has a hydroxyl group in the molecule.

Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan and Paul D. Dodge (US Patent: 4469525), here after Dodge, Jagannathan teaches the etching solvent comprising of hydrofluoric acid and an organic component suitable for etching oxides materials. However it does not teach using acetates as a specific organic solvent. Dodge teaches an etching solution for etching oxides such as concrete (abstract) comprising strong mineral acids, such as HF (table 1), with solvents, such as cellosolve acetate, also known as ethylene glycol monoethyl ether acetate (Table 1, solution j). Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a solution that

Jagannathan teaches which is comprises of HF and an organic solvent, and the organic solvent be cellosolve acetate because Dodges teaches that it is suitable solvent for strong mineral acid composition to etch the oxides.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Jagannathan and Klein et. al.(US Patent Number: 2003/0160026), here after Klein.

Jagannathan teaches the etching solvent suitable for etching the oxides comprising of hydrofluoric acid and an organic component and it does not specifically teach specific ether. Klein teaches an etching medium comprising ethylene glycol monobutyl ether [claim10] and hydrofluoric acid [0048] for etching oxide surfaces. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a solution comprising ethylene glycol monobutyl ether and hydrofluoric acid to obtain an etching solution for etching the oxides, because it is suitable for etching the oxides.

Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rangarajan Jagannathan (US Patent Number: 6200891), here after Rangarajan and Christenson et. al. (US Patent: 2003/0235985) here after Christenson.

Jagannathan teaches,

An etching solution comprising hydrofluoric acid and organic solvent for etching the oxides and meet the limitation of claim 1 as discussed above. He does not teach the method for etching the silicon oxide, high k film and the gate electrode. However, Christenson teaches,

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A process for etching high dielectric constant films more rapidly than coexisting SiO_2 , polysilicon, silicon and/or other films [abstract] comprising a solvent with at least one fluoride species [claim 30]. Christenson further teaches the method for selectively etching the high k dielectric (higher than 8, such as HfSiO) films with respect to silicon dioxide and a gate electrode [0027] comprising at least one fluorine ion, such as commonly used concentrations of HF [0032, 0020].

Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method to produce the same structure than applicant claimed by the method in which Christenson used, etching solvent comprising HF and an organic solvent, because the resulting structure seems to be identical with applicant etched article. The etched structure that obtained with the above method of is identical with what applicant has obtained.

Response to Argument

3. The amendment under 37 C.F.R 1.114(C) filed on March 18, 2008 under 37 CFR 1.131 has been considered but is ineffective to overcome the Jagannathan et al reference.

The applicant argues under Rule 132 Declaration submitted, the etching solution of the present invention provides remarkable effects and specifically an etching ratio (THOX/ HfSiO) of 1 or less. The examiner disagree, in table 1 or in any of the examples, the concentration of the ether compound (monoglyme) is not higher than 80% and the applicant claimed the concentration of the ether up to 97%. The applicant only used

monoglyme as the ether compound and the high k material is HfSiO_4 , however he claimed the ether compound to be a variety of the ether compounds and the high k film to be hafnium silicate zirconium silicate, alumina and etc.

Applicant's arguments filed on March 18, 2008 have been fully considered but they are not persuasive. The applicant argues the etching solution of Jagannathan is not based on only two components. Jagannathan clearly teaches an etching solution to selectively etch and removes native oxide and contains fluoride containing compound and an organic solvent [abstract]. Jagannathan teaches the amount of the water in fluoride containing compound affects on etch selectivity [column 3 lines 40-48]. Jagannathan teaches adding dehydrating agent to fluorine containing compound (HF) to remove the water [column 3 lines 49-60]. Jagannathan also teaches the organic compound is diglyme (ether) or propylene carbonate or esters or other organic chemical [column 4 lines 22-39]. In example 1, Jagannathan teaches adding the acetic anhydride in order to remove the water from the system not as an additive for etching and it is not required when the HF is not contains water.

Applicant argues the etching solution of Jagannathan 75-97% of ether; however the calculation on previous office action shows in fact the amount of ether Jagannathan used in the etching composition falls in this range.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tabassom T. Tadayyon-Eslami whose telephone number is 571-270-1885. The examiner can normally be reached on 7:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

T.T

/Michael Cleveland/
Supervisory Patent Examiner, Art Unit 1792